WT 21-141

PRESSURE TEST OF SEVERAL MODELS IN AIR-CARBON-DIOXIDE MIXTURES IN THE 21-INCH HYPERSONIC WIND TUNNEL

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I. INTRODUCTION

Wind-tunnel Test 21-141 was a test of five models in air-carbon-dioxide mixtures. The purposes of the test were to secure static pressures along the model surface and to survey the flow field from the model surface to the bow shock in mixtures of air-carbon-dioxide. The approximate aerodynamic parameters for the test were Mach No. 4.0, 5.5, and 6.5, and Reynolds No./in. 0.10×10^6. The test variables and ranges were angle of attack from -10 to +10 deg, angle of roll 0 to 90 deg, and 0 to 80% CO_2 to air.

The model configurations comprised a blunt nose-cylinder, a blunt nose-cylinder-flare, a conical nose-cylinder-flare, a spherical nose-cone, and a wedge.

The test was conducted at the Jet Propulsion Laboratory (JPL) from May 27 through June 18, 1963.

II. MODEL DESCRIPTION

The models are shown in Fig. 1 through 5. All models were made of stainless steel. Pressure orifices were sharp-edged and de-burred.

III. WIND TUNNEL AND INSTRUMENTATION

Reference 1 describes the construction and operating conditions of the 21-in. hypersonic wind tunnel. The wind tunnel has a nominal test-section size of 21 in. square, a Mach range from 4 to 11 in air, a flexible-plate nozzle, and operates with continuous flow. The operation of this tunnel with carbon-dioxide-air mixtures as a working fluid is described in Ref. 2. Table 1 presents representative values of the test-section flow parameters for the Mach numbers at which this test was conducted.

All body pressures were recorded by an automatic-switching system which permitted a single transducer to convert all the pressures to a digitized signal.

Pressures from the flow-field survey probe used individual transducers to convert pressures to digitized signals. The probe distance from the body surface was automatically read-out.

IV. TEST PROCEDURE

Two types of runs were made during the test: body-pressure measurement, and flow-field surveys with the probe. Data were recorded from both systems on most runs. The probe was retracted into the boundary layer of the tunnel during the body-pressure runs.

V. DATA REDUCTION

The data were reduced to pressure ratios on a digital computer. The following were output data:

1. Run and point number
2. Configuration
3. Angle of attack (deg)
4. Angle of roll (deg)
5. Stagnation pressure free-stream (cm Hg)
6. Stagnation temperature free-stream (°R)
7. Tunnel Mach number in air
8. Percent of carbon dioxide (CO_2) in working fluid
9. Distance from model surface to centerline of flow-survey probe (in.)
10. Distance from shoulder of body-nose junction to front of flow-survey probe (in.)
11. Reference diameter of model (in.)
12. Ratio of pitot pressure (free-stream) to stagnation pressure (free-stream)
13. Ratio of body-port pressure to pitot pressure (free-stream)
14. Ratio of pitot pressure (flow-survey probe) to stagnation pressure (free-stream)
15. Ratio of average-cone static pressure (flow-survey probe) to pitot pressure (flow-survey probe)
16. Ratio of difference in upper to lower cone static pressure (flow-survey probe) to pitot pressure (flow-survey probe)

VI. RESULTS

The results of this test have been reduced to pressure ratios and are on file at JPL. No attempt was made in this Report to interpret the results.

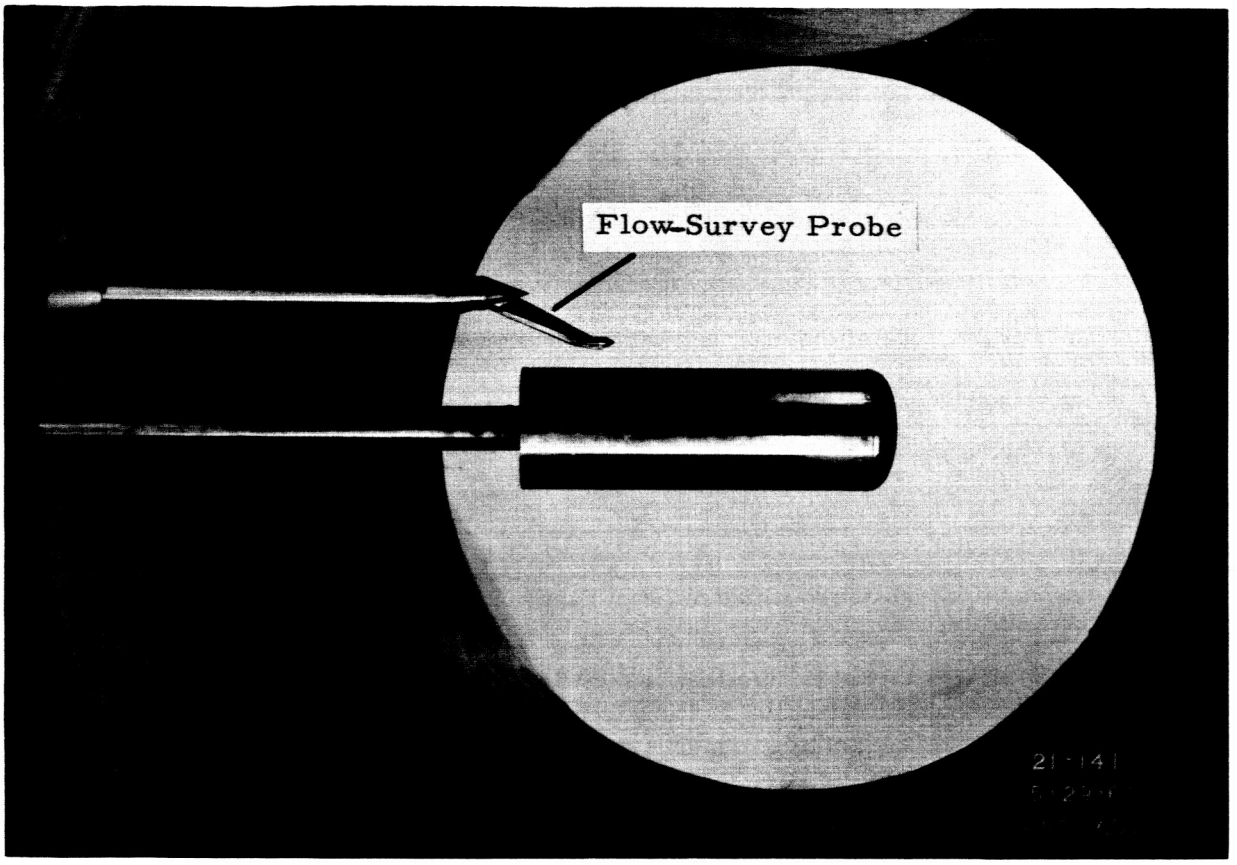
REFERENCES

1. Jet Propulsion Laborarory, California Institute of Technology. Wind-Tunnel Facilities at the Jet Propulsion Laboratory. Pasadena, California. JPL, 18 April 1961. (Technical Release No. 34-257) UNCLASSIFIED

2. Jet Propulsion Laboratory, California Institute of Technology. The Use of a Conventional Wind Tunnel as a Multigas Facility, by Howard Koester, Gilbert Herrera, and Donald Hanks. Pasadena, California, JPL, 8 April 1963. (Technical Memorandum No. 33-145) UNCLASSIFIED

Table 1. Average aerodynamic parameters in air

Parameter	Mach Number		
	4.00	5.50	6.50
Static pressure (psia)	0.317	0.145	0.074
Stagnation pressure (psia)	48.2	135	193
Dynamic pressure (psia)	3.56	3.07	2.20
Reynolds number (per in. x 10^{-6})	0.106	0.107	0.077



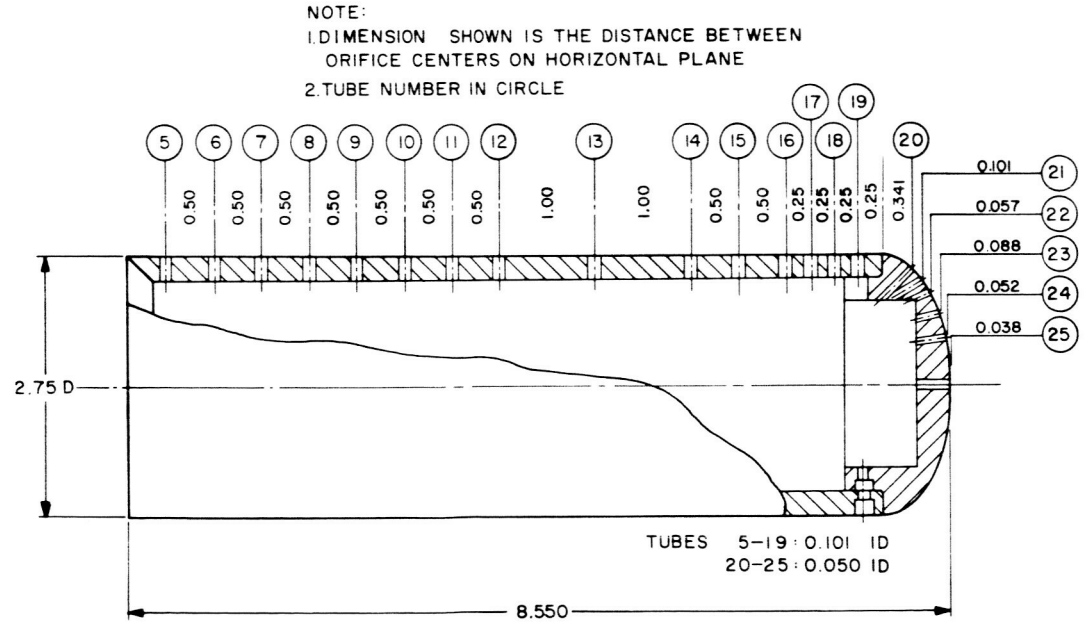
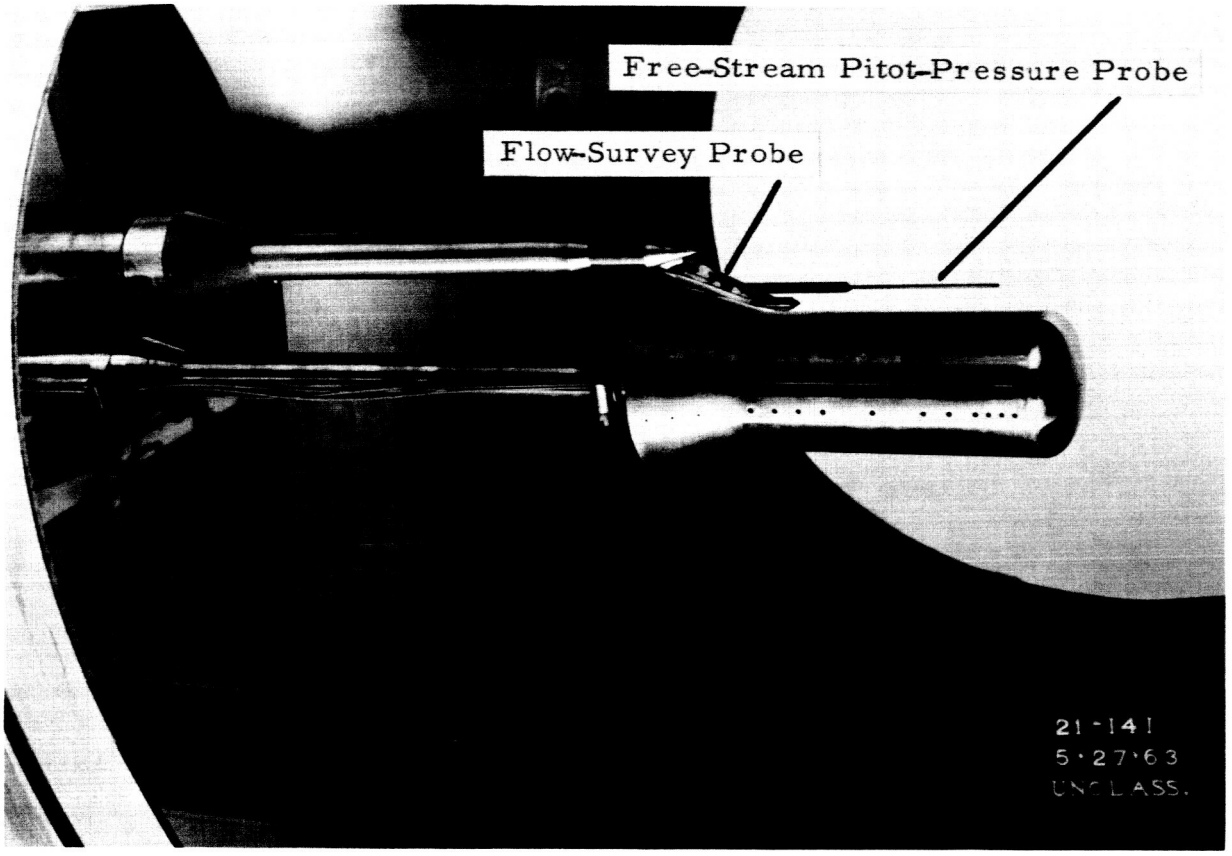


Fig. 1. Blunt nose-cylinder model installation and dimensions



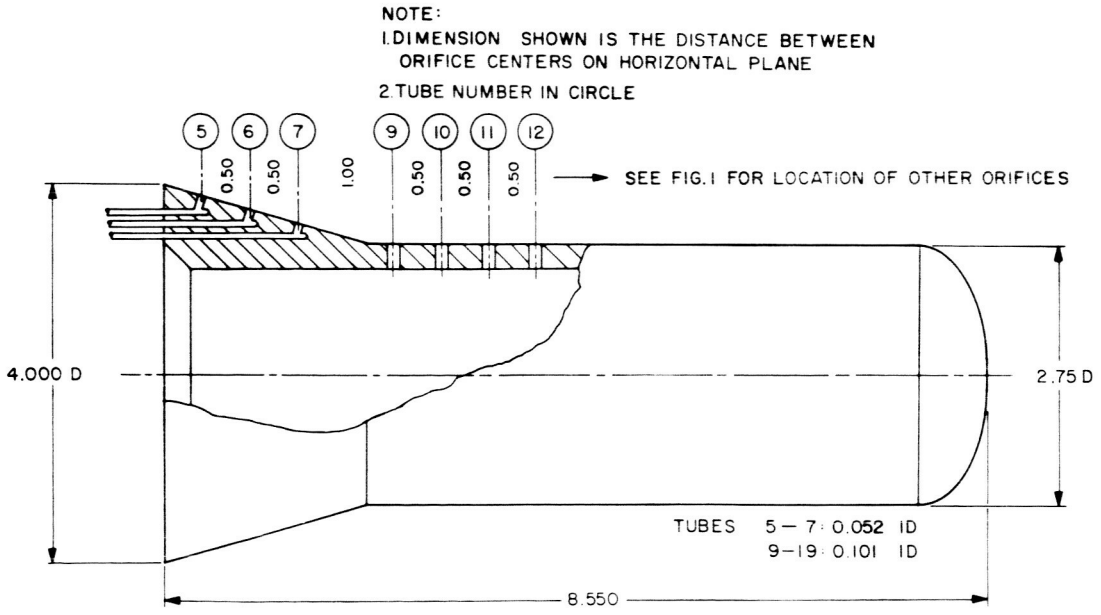
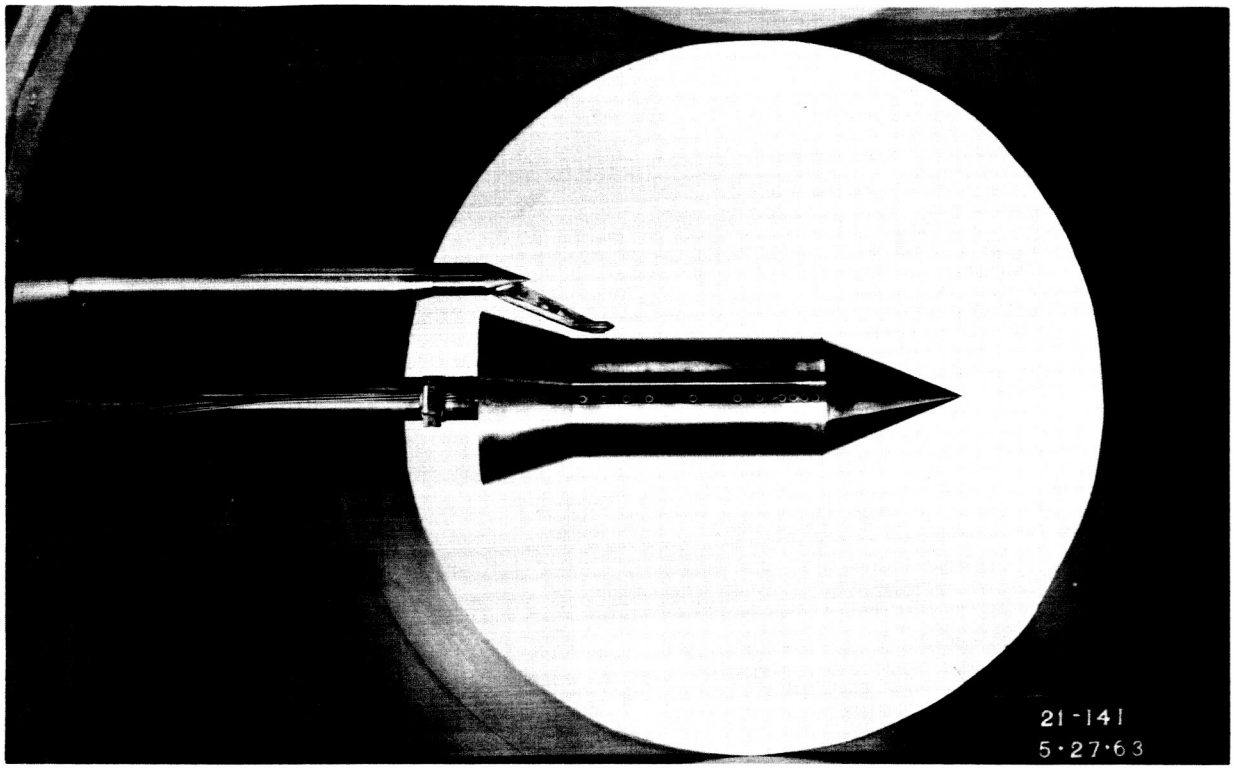


Fig. 2. Blunt nose-cylinder-flare model installation and dimensions



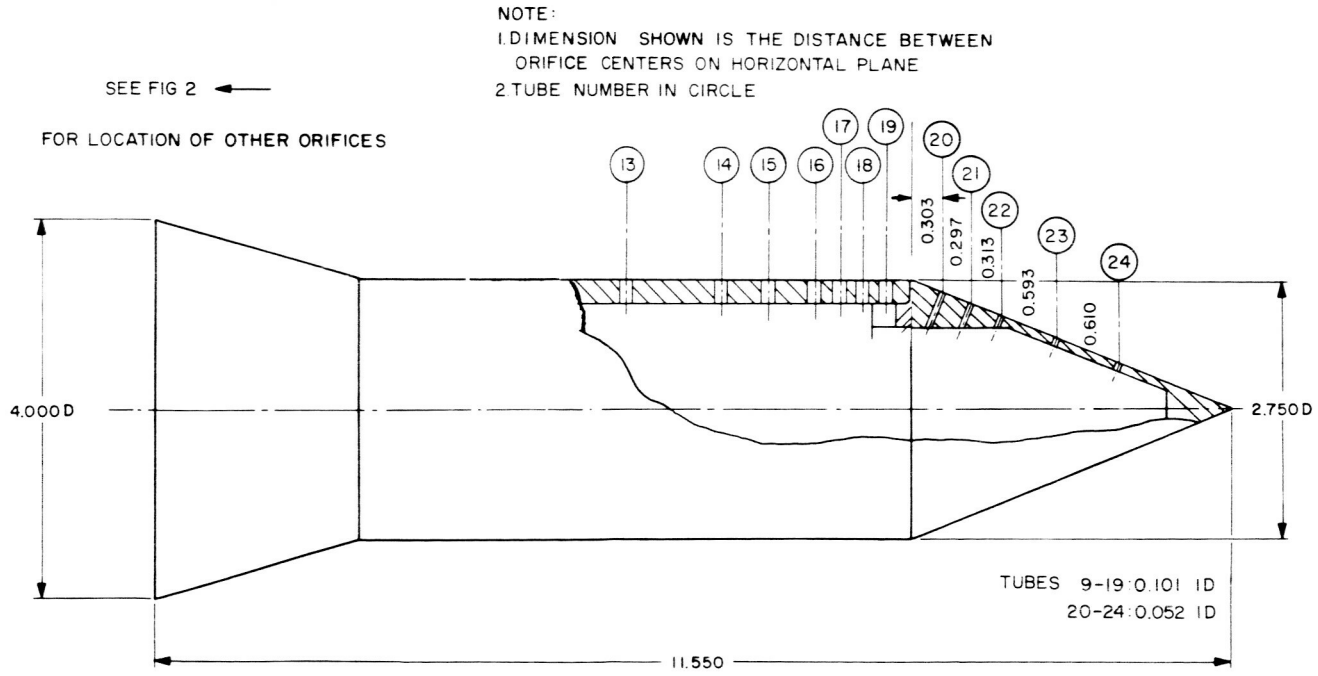
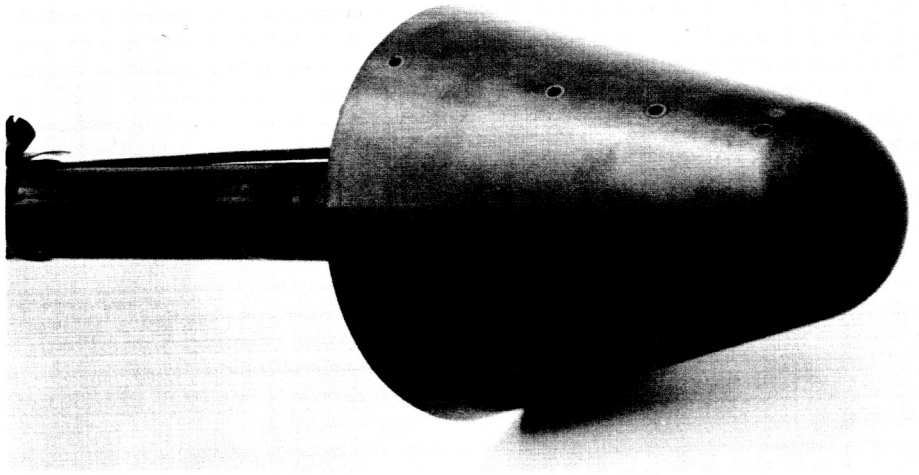
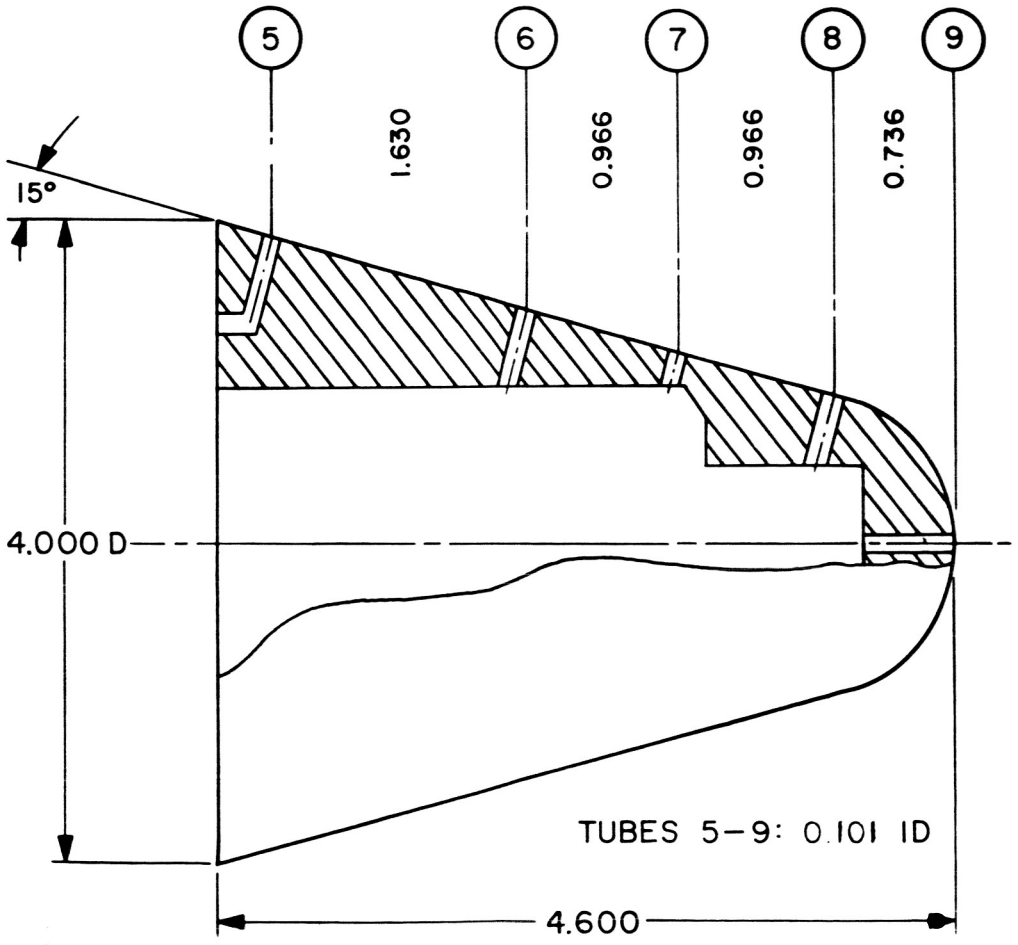


Fig. 3. Conical nose-cylinder-flare model installation and dimensions



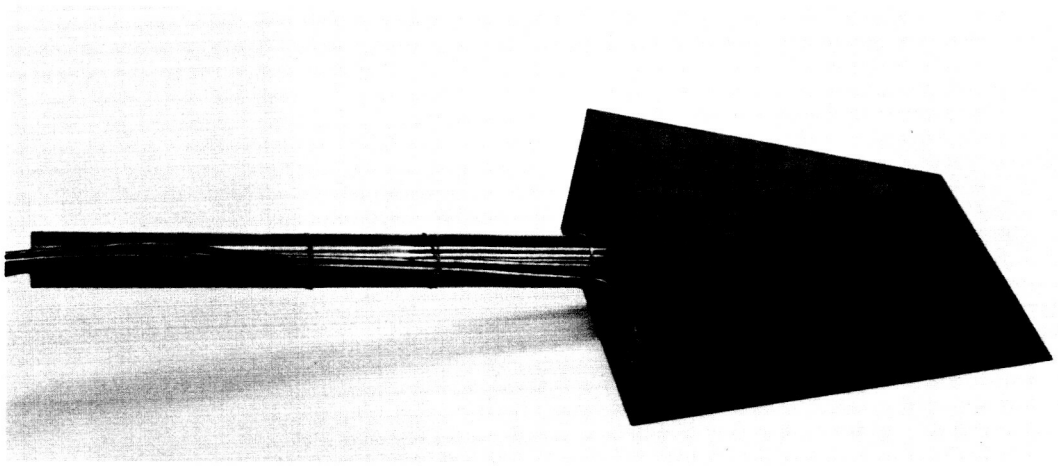


NOTE:

1. DIMENSION SHOWN IS THE DISTANCE BETWEEN ORIFICE CENTERS ON HORIZONTAL PLANE

2. TUBE NUMBER IN CIRCLE

Fig. 4. Spherical nose-cone model photograph and dimensions



Tubes	Inside Dia.
5 thru 9 and 11	0.071
10	0.107
12 thru 18	0.049

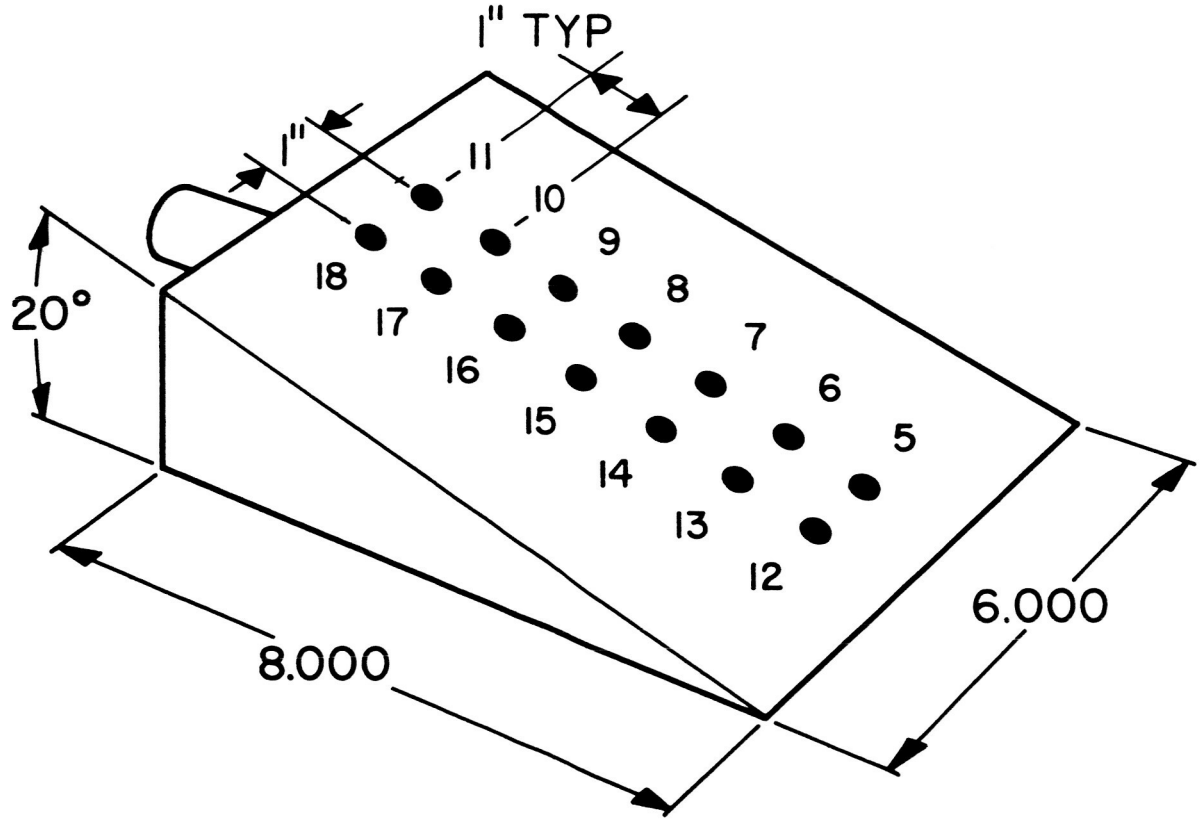


Fig. 5. Wedge-model photograph and dimensions